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AN EXPERIMENTAL STUDY OF CHILDREN AS OBSERVERS¹

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The current text-books of child psychology seem to be made up of (1) a summary of observations, often of the most casual sort, taken by differently trained observers on different individual children (*i. e.*, varying as to age, sex, heredity, environment, etc.) and under quite different conditions, (2) a presentation of statistical results of studies made of groups of children in classrooms, including mental tests; and, finally, (3) that admixture of sentimentality without which no text-book of child-psychology appears to be complete, but which would be ridiculed in a treatise of general psychology.

Much of the work has been done with single children, since the emphasis has been largely on the development of the child-mind, and it has accordingly been thought better to observe one child carefully from birth to early adolescence than to work with numbers of children. These studies of individual children² are interesting and valuable to child-psychology. They seem, however, to be but the beginnings of a child-psychology. Different investigators reach different conclusions and, at best, the number of reliable studies of this sort is small. Group-studies have concerned themselves, for the most part, with investigations of the "learning process" and mental tests, and have had pedagogical applications as their goal. Few of the studies are comparable with the experimental studies of the "adult mind," and therefore the text-book of child-psychology

¹From the Psychological Laboratory of Smith College.

²Cf. W. Preyer, *The Mind of the Child*, 1890; M. Shinn, *The Biography of a Baby*, 1900.

has not as a basis the results of experimental work which make possible the definite statements of fact in general psychology.

One reason for this difference is the tacit assumption that the child cannot describe his experiences, and that he cannot and should not be brought into a laboratory where the conditions of experiment can be controlled and repeated under exactly similar conditions with other children. Many writers declare that the atmosphere of a laboratory is unnatural and that the child brought there becomes, for the time, an unnatural being. The first objection—that children can not describe their experiences—seems more serious. But Binet in 1903 writes of his work with Armande and Marguerite: "Les recherches que j'ai pu faire sur ces deux enfants sont extrêmement nombreuses et se sont espacées sur trois ans. Elles s'y ont prêtées avec beaucoup de bonne grâce, sans timidité, ni fou rire; elles ont toujours compris qu'il s'agissait d'une chose sérieuse, et elles étaient persuadées que le moindre erreur pouvait me causer un préjudice des plus graves. Plût au ciel que les adultes qui servent de sujets aux psychologues eussent toujours une attitude aussi bonne!"³ At the close of the book he says further: "J'ai été aidé dans cette oeuvre difficile (la nature de la pensée) par ces deux enfants qui ne savent pas le premier mot de psychologie."⁴ More recently E. R. Jaensch and his students⁵ report the observations of children, 11 to 17 years of age, in experimental investigations.

The experimental work about to be described has had an aim somewhat different from those governing the work of Binet and Jaensch. We have been interested in the ability of children to make psychological observations rather than in the study of any bit of experience for itself. Our work has been in the field of visual sensation; but our aim has been, primarily, not to contribute any new data to the child-psychology of visual sensation, but to find out how accurate and reliable descriptions of experiences a child can give in a laboratory under controlled conditions. We have used experiments in visual sensation because this field has been so well worked over that we had furnished a basis for comparison of the observations made by children with those made by adults. Our problem has been largely one of method.

There were eight Os: M. (4 yrs. 8 mos.), B. (5 yrs. 6 mos.), K (9 yrs.), J. (10 yrs. 6 mos.), I, (11 yrs.), F. H. (11 yrs.), F. B. (17 yrs. 5 mos.), and A. (20 yrs.).⁶ F. B., a freshman in college,

³A. Binet, *L'étude expérimentale de l'intelligence*, 1903, 10.

⁴*Ibid.*, 308.

⁵*Zeits. f. Psych.*, 84, 1920, 1ff.; 85, 1920, 37ff.

⁶B. and K. were boys; the others, girls. M. and B. were children whose mothers worked as maids in the college houses and who, therefore, had a poorer home environment than the other Os.

and A., a junior, were chosen as older *Os* in order that we might make some comparison of the character of their reports and those of the six children. None of the *Os* had had any previous experience in a psychological laboratory, but A. had taken a one-semester course in introductory psychology.

J. and F. B. came to the laboratory one hour a week for 21 consecutive weeks with the exception of the college vacation periods. The number of weeks devoted to experimental work with the others was shorter, owing to delays in starting or to interruptions. F. H. was unable to come to the laboratory after the first 11 weeks; and the fact that B. was ill for 6 weeks caused an interruption in his observations. We did not start work with A., I., K., and M. until after we had been working with the others for several weeks. With K., especially, the work was crowded and incomplete. M. observed in only 7 parts of the experiment, and her observation-periods were often shorter than an hour.

Because of the age of the *Os* it was necessary to give the instructions in as simple language as possible and to avoid all suggestion. Absolutely no conversation, after the giving of the instructions, took place between *E* and the *Os*. All of the experimental work was done in the psychological laboratory. We endeavored to make the work interesting, and the children apparently liked to come. We found it impossible to get reports on a single phase of an experiment for a whole hour, for the children tired easily. We feel quite definitely that shorter observation-periods would be better; but it seemed impossible to arrange for a number of shorter periods, so that we had to make the most of the one hour a week that the children gave us. To obviate fatigue and loss of interest, we varied our procedure during the hour of observation, securing, for example, reports upon the after-image both in the dark room and outside.

EXPERIMENT A

We began the experimental work with a study of the after-image, since here we had an objective check on the experiences of the *O*. It should be noted, however, that this is not an obvious observation, for many psychologically untrained adults fail to observe the after-image even when their attention has been called to the phenomenon. Our instructions carefully avoided all such suggestion.

We attempted to verify the following laws of the after-image. (1) The color of the image is always antagonistic to the color of the stimulus. (2) A contrast-color in the stimulus is effective in the after-image. (3) The after-image is intermittent or periodic, not continuous. (4) The intensity of the after-image is a function of the intensity of the stimulus.

Procedure.—(1) In the verification of Law 1 we used adaptation-cards (18x24 in.) of different shapes: (a) oblong, half-black, half-white, with a small circle half-white, half-black, which served as a fixation-point, slightly above the middle of the median line; (b) circle, half-white, half-black; (c) diamond, half-black, half-white. Each card was exposed to the *O* for 30 sec. The instructions were: "I want you to look at this cardboard about here (a point slightly above the middle of the median line, indicated by *E*) until I put the gray cardboard over it like this. Then look at the cardboard and tell me what you see; tell me all about it."

TABLE I

After-Image Reports											
WITHOUT TRAINING						WITH TRAINING					
Os	No. Trials	A.-I.	Qual.	Period	Mvt.	Weeks Train.	No. Trials	A.-I.	Qual.	Period	Mvt.
M	7	0	0	0	0	—	—	—	—	—	—
B	4	0	0	0	0	26	8	—	6	0	—
K	8	7	7	1	1	9	3	3	3	1	0
J	13	13	13	0	4	23	8	8	8	0	4
I	11	11	11	0	1	12	8	8	8	1	0
FH	13	13	13	0	2	—	—	—	—	—	—
FB	11	11	11	2	0	22	8	8	8	0	0
A	8	8	8	0	1	9	8	8	8	0	0

Results.—The above table indicates the number of trials for every *O*, the number of times an after-image, the correct quality, a periodicity, and a movement were reported spontaneously.

M. and B., the two youngest *Os*, gave no reports, declaring that they "saw nothing." All of the other *Os* described the after-image. It should be remembered that we did not ask for a report on any one aspect of the after-image, so that all descriptions were spontaneously given. Our procedure throughout the work has been to try for a spontaneous report of a given phenomenon and, having obtained it, to ask for it directly in the instructions of the next experiment. We hoped by this procedure to avoid all suggestion.

Samples of the *Os*' reports follow. In view of the purpose of this experiment they seem to the *Es* quite as important as the statistical results. They show the naiveté and the good faith of the *Os*, and give some indication of the difficulties of procedure where so young *Os* are used.

Samples of Reports. The numbers in parentheses indicate the number of the trial for which the report was given.

K. (2) "White on this side and black on that. How did it come through? Saw it, and then when I was telling you I saw it again."

J. (1) "One half of the page on the right side like a white piece of paper and like a little hollow in half of it."

I. (4) "I have the feeling something funny is coming with this. It is a circle like the other one, only turned around."

F. H. (2) "Side that was white is black and side that was black is white."

Results.—As in Table I, we have given the number of trials for every *O*, the number of times an after-image and the correct quality were reported, and in addition the description of a contrast-effect in the stimulus or in the after-image. For the first 6 trials with each stimulus color *M* gave no report. After this, with 3 exceptions noted above, she always reported "black." This "black" may have been the brightness-aspect of the after-image or merely the blackness of the dark room; the former seems the more probable hypothesis, since when *M* "saw" nothing, she gave no report at all. *B.* showed considerable improvement and the other *O*s, as the samples of reports will show, gave more accurate descriptions.

Samples of Reports

- M.* (7) "Blue and black." (Stim. yellow.)
B. (7) "Don't see nuthin, don't see nuthin', don't see nuthin'. I see green, green, green." (Stim. red.)
K. (3) "Green. I close my eyes and I see green." (Stim. red.)
J. (2) "Kind of a green square with a red line around it, moving around." (Stim. red.)
I. (2) "Biggest green square, keeps coming and going like a flashlight. When I took my eyes off of the red everything went green." (Stim. red.)
F. H. (1) "Oh, oh! I see green with light yellow around it, pretty." (Stim. red.)
F. B. (4) "I see at first lightish blue-green and then it changes into dark green. Outside of it is a circle of pale yellowish light, then just blue green square, then nothing." (Stim. red.)
A. (1) "Purple, sort of bluish-purple, with yellow haze around it. . . . it gets darker." (Stim. yellow.)

(3) After several trials with every stimulus the additional instruction was given: "Now this time I want you to say 'go' when what you see has gone. Say 'come' when it come sand 'go' when it has gone."

Results.—All of the *O*s except *M*, who did not observe in this part of the experiment, reported not only the first and the last appearances of the after-image, but noted several reappearances as well.

Now that the *O*s had spontaneously noted the periodicity of the after-image, the instructions were: "You saw that the color went and then came back. Now this time I want to know how many times the color comes and goes. When you first see it say 'come' and if it goes say 'go,' and so on. In short, every time you see the color say 'come' and every time it goes say 'go'." There were at least 3 exposures of the red stimulus and 3 of the green.

Results.—All of the *O*s (except *M*) reported recurrences of the after-image, varying in number from one to seven. The two older *O*s were more regular in their reports of periodicity, but otherwise there was little difference between the reports of the older and the younger *O*s.

(4) We asked next for a description of the after-image with eyes closed. The instructions were given as in A 2, with this change; instead of: "Then look at the card and tell me what you see," the Os were told: "Then shut your eyes and tell me what you see."

Results.—All of the Os described correctly the quality of the after-image with the exception of the after-image with the yellow stimulus. B. called this "black", and I. gave no report whatsoever. It is worthy of note that the Os now report not only quality but also shape, and frequently contrast-effect, in the after-image. The report given by B., cited below, is the first of a number of this kind.

Samples of Reports

B. (1) "Green mark, yellow mark, green tree, green house, green river, green sidewalk, people swimming around the edge." (Stim. red.)

K. (1) "I know what it's going to be. . . . see it on the floor now. Square of blue." (Stim. yellow.)

J. (1) "Purple square with green around it." (Stim. green.)

I. (1) "I see something funny. . . . a blue square and a green square." (Stim. red.)

F. H. (1) "Cerise-purple, it's dandy." (Stim. green.)

F. B. (1) "Purple square with pale circle of light outside." (Stim. green.)

A. (1) "Bluish-purple square with light yellow haze around it. Doesn't come as quickly with eyes shut as with the card." (Stim. yellow.)

(5) In order to obtain a description of contrast-effect in both stimulus and after-image the stimuli were exposed for 45 sec. each. The instructions were: "Tell me what you're looking at; tell me all about it"; and when the O had reported contrast in the stimulus, "Just tell me about the color." Then followed the after-image contrast instructions: "When I put the card over this I want you to tell me just about the color you see."

Results.—This proved to be a difficult observation to make. We were, perhaps, over-cautious in the phrasing of the instructions, which certainly gave the Os no clue as to what we were after, and which may have developed a set against a report of contrast because of similarity to the instructions used in A 1 and 2. However, all of the Os (B's report is questionable; but it seems probable that he observed a contrast-effect in the stimulus) described a contrast-effect in the stimulus; but only one of the Os, J., always observed a contrast-effect in the after-image, though F. H. described it once out of twelve trials. J. was the best of the younger Os. She came the most regularly to the laboratory, so that she had more practice than the others.

Samples of Reports

B. (4) "An automobile with green." (Stim. red.)

K. (1) "Blue right under it." (Stim. yellow.)

J. (1) "Dark around square, green around it." (Stim. red.)

I. (1) "Dark spot in the middle, light green off to the side." (Stim. red.)

F. H. (1) "Green getting around it; red with green rim around it." (Stim. red.)

F. B. (1) "Blue-purple around outside." (Stim. green.)

A. (5) "Green square. Right now it is getting lighter in color, more yellowish, except that now I see the negative after-image of dark reddish purple covering part of it, and that makes the center look like dark blue-green. It seemed to be getting darker and then all of a sudden I realized that it was a darker square getting over it." (Stim. green.)

(6) To obtain a description of differences in intensity, we covered half of each of the glass squares with tissue paper, so that the one half of the square appeared much brighter than the other. The instructions were: "I want you to look at this until I put the card over it; then look at the card and tell me what you see; tell me all about it." The exposure time was 30 sec.

Results.—B., K. and I., after several trials, gave no reports of differences in brightness. J., F. H., F. B., and A. gave satisfactory reports.

Samples of Reports

J. (1) "Kind of purplish; half light purple and half blue, yellow around it." (Stim. yellow.)

F. H. (1) "Where green was, it's purple; where it had white paper on it, very light." (Stim. green.)

F. B. (4) "Pale green on the left, darker blue-green on the right." (Stim. red.)

A. (1) "Purple on one side. . . . can't describe the shade on the other it's more brownish and lighter." (Stim. green.)

(7) During the course of the experimentation in the dark room, we asked the *O*s to describe the after-image from an electric light. The instructions were: "I'm going to pull the light on and off three times. When I say 'now' I want you to tell me what you see in the darkness; tell me how the light looks in the darkness."

Results.—All of the *O*s described both the positive and negative after-images, though the reports varied in exactness and in the number of colors described. The youngest *O*, M., in the twenty-third trial gave the following sequence of colors: "Grey, yellow, red, blue, green." Samples of reports from the other *O*s follow.

Samples of Reports

J. (4) "Yellow strings, then lavender, then yellow."

B. (1) "Red coming down, red coming down, red coming down, yet down like a fire."

K. (3) "Those little wires I see. . . . a little green over those wires."

I. (1) "Big round circle, light in the middle of it, like a lamp hanging up high."

A. (6) "Yellow, shape of bulb. . . . I think I see some blue."

At the conclusion of the whole of our experimental work we repeated this part of the experiment. The reports were all more detailed, *i. e.*, more colors were observed.

J. (3) "The wires are first red, then they turned lavender and then purple, and then black."

(8) This part of the experiment we conducted under ordinary daylight conditions. A brief explanation of the term "after-image" was given to the Os.

(a) Small red, green, yellow and blue squares of paper about 4x4 in. were fastened on gray backgrounds. Each was exposed for 30 sec. The instructions were: "I want you to look at the color until I put the card (gray) over it; then look at the card and tell me all about the after-image."

Results.—All of the Os, except M., who failed to observe the negative after-image, described correctly the quality of the after-image, and reported spontaneously stimulus-contrast, movement, and periodicity. The older Os named the colors of the negative after-image more accurately, as, for example, "bluish-purple," "turquoise-blue," etc.

(b) Small green, blue, and red squares of paper were fastened on gray backgrounds. Blue, red, and green backgrounds were used for the projection of the after-image. The instructions were the same as in (a).

TABLE III

	Stim.	Bkgd.	Stim.	Bkgd.	Stim.	Bkgd.	Stim.	Bkgd.
	Green	Blue	Blue	Red	Blue	Green	Red	Green
O	Trial	Report	Trial	Report	Trial	Report	Trial	Report
M	—	—	—	—	—	—	—	—
B	1	blue*	1	yel., red	1	—	1	green, blue*
	2	blue, green	2	yel. marks	2	green*	2	—
	3	blue	3	blue, red	3	yel., blue, red		
			4	blue, red	4	yel., green		
K	1	purplet	1	purplet	1	yellow†	1	blue
			2	orange†			2	blue
J	1	purple*	1	yellow*	1	yellow*	1	—
			2	yellow	2	yellow*†	2	green*
I	1	purple*	1	scarlet	1	green*†	1	lt. green
			2	yellow†				
			3	scarlet*				
FH	1	cerise	1	orange	1	yel. orange	1	dk. green
					2	orange	2	wh. blue
					3	yellow		
FB	1	purple*	1	orange	1	yellow	1	blue-green
					2	strong		
						yellow		
A	1	purple*†	1	orange*†	1	greenish-yel.*	1	blue-green

*—shape reported

†—periodicity reported

‡—movement reported

Results.—M. observed no after-images. B.'s reports are again questionable. In trial 2 with the green stimulus and the blue background he may, for example, have seen the "correct" purple, which he called "blue," and his "green" may have been the contrast-effect from that. This is mere conjecture, however, and as such worthless. The case cited shows one of our difficulties with the younger Os, a just interpretation of reports. With the blue stimulus and the red background in trial 1 his

report of "yellow" is correct; but in the following trials with the same stimulus and the same background there are no similar reports. This variability is another characteristic of young Os.

(9) In order to determine the effect of training and also to test the possibility of using written instructions, in a final synthetic experiment we used either purple or blue colored glass shown to the O in a manner similar to that described under (2).

(a) Before each of the three 45 sec. exposures the following instructions were read: "I'm going to show you a color and I want you to look at it until I put the card over it; then look at the card. When the after-image comes, watch it until it has gone for good, and then tell me all that you can about it. Tell me all the different things that you've been telling me during the last few weeks, but be sure not to tell me any of these things until the after-image has gone for good."

Samples of Reports

B. (6) "Green piece of grass and green lettuce and a white boat and a red boat and that's all." (Stim. purple.)

I. (1) "Green square and it stayed in the middle of the board. When there's purple there's green around it, and when there's green there's purple around it." (Stim. purple.)

F. B. (3) "Pale circle of bluish light with muddy brown yellow. It comes and goes and it decreases each time in brilliancy." (Stim. blue.)

(b) At least two more 45 sec. exposures were made, but this time before each the Os were asked to read the following typed instructions. (B. could not read the typed instructions so that E read them to him.) "I am going to show you a color and I want you to look at it until I put a card over it. Then I want you to look at the card. When the after-image comes, watch it until it has gone for good, then tell me all that you can about:— (1) the stimulus, its color; (2) the after-image, its color, its size and shape, its coming and going."

Samples of Reports

B. "The stimulus is pink. The after-image is green. It comes and goes, is square."

K. "The stimulus is purple and the after-image green. It came and went and was the same size and shape."

I. "On the stimulus is a little light circle. The after-image is a light green that comes and goes. It is a little bit smaller than the stimulus. It was square."

J. "The stimulus was purple. The after-image is a sort of white cloud. I think it went twice."

F. H. "The stimulus was blue, the after-image yellow. It was the same size and shape as the stimulus. It came and went twice."

F. B. "The stimulus was a purplish-blue, the after-image came and went about three times. It stayed longer the first two times. It was a square about the same size and the square was a muddy brown yellow surrounded by a light pale bluish color."

A. "The stimulus was a reddish lavender. It got darker but that was the negative after-image which was not quite on the square but overlapped

it. The after-image came almost immediately; a dark olive-green square the same size as the stimulus. It gradually got darker and faded into the background."

The reports indicate a great improvement over the earlier ones, and show that even very young *Os* can report on a number of details and that written instructions can be successfully used.

(10) Our final experiment in this group was an attempt to see if these young *Os* could compare two after-images with respect to brightness. One 30 sec. exposure was made with the plain blue glass. When the after-image from that had disappeared, another 30 sec. exposure was made of the blue glass covered with thin white tissue paper. The instructions were: "I am going to let you see two after-images, one after the other. Try to remember how the first one looks and, after you have seen the second and it has gone for good, tell me how the two are different from each other."

Results.—This differs from any of the former procedures in that a report can not be "read off" from the immediately present experience. B. and I. reported no difference in brightness, but all the other *Os* noticed and described the change in this aspect.

Summary of Results and Conclusions

(1) All of the *Os* reported the presence of the after-image, positive and negative, and described correctly its quality, at some time during the experiment. With the exception of M., the youngest, all described the intermittent character of the after-image and a contrast-effect in the stimulus. The relation between the duration of the stimulus and the duration of the after-image was observed by the older *Os*, I., F. H., and A.; the effect of contrast in the after-image by J. and F. H.; differences in brightness by J., F. H., F. B., and A.

(2) The *Os* improve with training. B. and M., the youngest, "saw" no after-image at first, but after training described it correctly. B. gave no reports of any sort during the first 2 hours that he spent in the laboratory, so that we felt that we had reached the lower age limit in the *O* of five and one half years. We decided, however, to "try again," and in the next observation hour B. gave accurate reports, and so improved with training that he frequently matched the older *Os*. We had much the same sort of experience with M. She was still younger than B., but like B., lacked the better training and home environment that the other *Os* had. We worked with M. for only 6 hours, and her reports are inaccurate. However, they show a progressive improvement, and point to the conclusion that the ability to describe one's experiences is a matter of training rather than of age, except so far as the understanding and use of language are correlated with age.

The older *Os* improve with training in accuracy of report and in the number of details they give. J. was the best of the younger *Os*, but she came the most regularly and for the longest period of time to the laboratory. Training, then, is very important. It involves not only improvement in the use and understanding of the language of description, but also an adaptation to the atmosphere and requirements of laboratory work.

(3) The greatest difference between the younger *Os* and the older is the lack of stability of judgment on the part of the younger ones; that is, when an *O* gave a correct report, this was no guarantee that he would continue to do so. A careful description was quite likely to be followed by one, or several, which seemed to have nothing to do with the experience; or by no report at all. This was especially true of M. and B. and, to some extent, of K. and I., though their stability of judgment improved with training. It seems probable that this variability shown by the youngest *Os* was correlated to some extent, at least, with fatigue and ennui. Shorter observation periods might not eliminate it, but they would help to decrease it. J. and F. H. differed very little in this respect from the older *Os*, F. B. and A. Indeed, toward the close of the experimental work, we hardly looked upon J. as a "younger *O*". K. and I. had so much shorter periods of training than B., J., and F. H. that their reports are not strictly comparable.

(4) The reader will have noticed the naiveté and, in some cases, the crudity of the reports. The younger *Os* obviously know only the more simple color-names. We have not had many difficulties in interpreting the reports. They are more comprehensible because of their frankness than many reports of older *Os* in other experimental work. B.'s reports are an exception to this statement. His descriptions of "grass," "lettuce," and "boats" are not easily interpreted. How much of the imagery is based on directly preceding sensory conditions and how much of it is supplementary imagery cannot be said. *E* at no time criticized B. for this type of report or commented on it, except by saying at the beginning of the experiment: "Now tell me *just* what you see."

EXPERIMENT B

Since the *Os* had improved with training, we continued our work in the field of visual sensation and took up next a study of *adaptation*. Observations in this field proved difficult for young *Os* because of the constant fixation of considerable duration (for children) which is necessary, and the slowness with which adaptation takes place, resulting in discouragement and monotony. We spent only from 2 to 3 observation-periods on this part of the experiment, so that the *Os* had comparatively little

training. Several of the children complained that the work hurt their eyes, so that it seemed wise not to give more time to it.

Procedure.—(1) The *O* was seated facing a large window. Directly in front of him was placed a square of green glass, arranged in such a way that all lateral light was excluded. The instructions were: (a) "I want you to look through the green glass and tell me about the color of things. Keep looking and tell me how the color changes. (b) When you look away, tell me how the things which you see look."

Samples of Reports

M. (2a) "The sky is green, the road green, everything green and green and green" (at end of 3 min.).

(2b) "Everything is white, no, red."

B. (1a) "Everything is green. white. the church is pink. . . . road green. getting black" (at end of 2 min. 20 sec.).

(1b) "When you look off things look pink."

K. (1a) "Everything is just green. darker green. lighter green" (at end of 3 min.).

(1b) "Pink. oh, awful pink."

J. (1a) "The sky is green, the automobiles look green, the church green," etc. (at end of 6 min.).

(1b) "Things look sort of pinkish. you look sort of pink. whiter than you did."

I. (1a) "Green. everything yellow. now green again. the church is a horrid olive-green color. the trees purplish, the sky bright green" (at end of 2 min. 30 sec.).

(1b) "Everything bright red. American Beauty color."

F. B. (2a) "Green. grayish-yellowish green. gets grayer" (at end of 45 sec.).

(2b) "Pink at first, changes back quickly."

A. (1a) "Everything is green. everything a little duller. doesn't really look green to me now. I don't know what color, just natural. a little grayer. even the grass looks gray" (at end of 2 min. 20 sec.).

(1b) "Red! Just as red as it can be."

(2) In order to obtain a report on adaptation to light we used the following instructions: "I'm going to take you into the dark room and we are going to stay there for a short time. (a) When we first go in tell me how it looks and, as we stay in there, tell me how it changes. (b) When we come out into the light, tell me how it looks and how it changes."

Adaptation to darkness was reported by all *O*s except B. M. did not observe in this part of the experiment.

Samples of Reports

B. (a) "Dark. green, red. green, blue. and a dog and a boy. dark, red, white. automobile and a blue sky and a stork. hoop and a boy rolling it", etc. (after 11 min.).

(b) "All dark. now all white."

K. (a) "Black. red, dark. red now, it was pinkish last time. pink. look at my knee. black still" (after 7 min.).

(b) No report.

J. (a) "Black can't see anything all dark trying to see something all dark I begin to see a little better can't hardly see anything though begin to see things every minute or so I see a few more things" (after 15 min.).

(b) "Very bright not so bright."

I. (a) "Can't see anything black right in front of my eye it's lighter seems darker than when I first came in light circles twirling before my eyes light near the table" (after 8 min.).

(b) "Bright!"

F. B. (a) "Black little gray spots float around black it's browner than it was, not so deep a black the blackness doesn't hit you as it did when you came in. It is not as hard to sit with your eyes open looking straight ahead there is grey, black from the sides white spots and gray mixed" (after 11 min.).

(b) "Everything looks natural."

A. (a) "Just dark I can't see a thing little lighter no objects but gray perhaps a lighter gray a little light streak quite a bit" (after 17 min.).

(b) "Light, very bright, almost dazzling."

(3) The *O* was seated with his head secured in a head-rest. Five feet in front of him was placed a yellow card with a fixation point. The instructions were: "I want you to sit here with your head in the head rest like this. Then I want you to look at this card about here. As you look at it, tell me what you see, tell me all about it. Keep on looking at it and keep on telling me what you're seeing. (After *O* had reported a change these additional instructions were given.) You saw there was a change in the color. Now just tell me about the changes as they occur." The time of exposure varied according to the nature of the report.

Samples of Reports

B. (2) "Red and a mark and a square mark gray a round hoop white and blue and that's all looks blue yet."

J. (2) "Yellow light streaks around the sides, top and bottom light streaks around the sides or else the middle is darker, I don't know which almost all the card is a darker yellow, but around the edges it gets lighter."

I. (1) "Funny dark square a darker yellow except on the edges where it's the color that it really is much darker half dark, half light."

F. B. (1) "Yellow a brighter yellow around the edge and brownish in the center if anything, it becomes more brown."

A. (1) "Light around the spot (fixation point) a little darker, the whole thing is a very dirty yellow now it is almost the same color as the table I can't tell where it leaves off very grayish."

Summary of Results.—The *O*s clearly need more training in describing the course of adaptation. Some of the reports, however, are good. In B, 1 and 2, all of the *O*s, except K., noticed the after-effects of adaptation. In B, 3 an especially difficult observation was asked for. The nature of the reports shows that changes due to adaptation were observed, but that the work needs considerable refinement. This part (3) of the experiment was very disagreeable to the children, who grew tired

of "waiting for something to happen" and who could not maintain a steady fixation. All but B. and K., nevertheless, describe some of the effects of adaptation. B.'s tendency to give meaningful descriptions is shown throughout the experiment.

EXPERIMENT C

In the next series of experiments we asked for descriptions of contrast-effect.

Procedure.—(1) On backgrounds of red, green, yellow, blue, white and black papers were pasted figures of gray paper. Both were covered by thin white tissue paper. The instructions were: "I want you to tell me the color of each figure as I show it to you."

Results.—We give in full a table of the results of this experiment in order to show how the reports of the different Os compare with one another. It will be seen that the older Os got the contrast-effect more quickly, that is, with fewer trials, than the younger; though all, even M. and B., made the observation. Observation of contrast-effect was much easier than observation of adaptation, as is, of course, to be expected.

TABLE IV

	Red	Green	Yellow	Blue	White	Black
M	1 white 2 " 3 " 4 " 5 " 6 "	1 gray 2 " 3 " 4 pink 5 " 6 "	1 gray 2 "blue 3 blue 4 " 5 " 6 "	1 gray 2 " 3 " 4 " 5 " 6 yellow	1 gray 2 " 3 " 4 " — —	1 gray 2 " 3 " 4 " — —
B	1 white 2 gray 3 " 4 white 5 gray 6 white	1 gray 2 pink 3 gray 5 pink 4 " 6 "	1 gray 2 " 3 " 4 " 5 " 6 choc.	1 gray 2 " 3 " 4 " 5 " 6 yellow	1 brown 2 " 3 " 4 " 5 " 6 "	1 gray 2 " 3 " 4 " 5 " 6 "
K	1 white 2 " 3 green 4 brown 5 green	1 reddish 2 brown 3 red 4 " 5 "	1 brown 2 " 3 blue 4 " 5 brown	1 white 2 yellow 3 " 4 " 5 "	1 brown 2 " 3 dk. " — —	1 white 2 " 3 " — —
J	1 green 2 " 3 " 4 "	1 reddish 2 pink 3 " 4 "	1 blue 2 " 3 " 4 "	1 yellow 2 " 3 " 4 "	1 black 2 " 3 " 4 dk. gray	1 gray 2 " 3 " 4 lt. gray
I	1 gray 2 " 3 " 4 " 5 "	1 pink 2 " 3 " 4 gray 5 dk. "	1 lt. gray 2 " 3 gray 4 " 5 dk. "	1 dk. gray 2 " 3 gray 4 " 5 lt. "	1 dk. gray 2 " 3 gray 4 " 5 dk. "	1 white 2 lt. gray 3 gray 4 " 5 lt. "
FB	1 blu.-gy 2 " 3 blu.-wh 4 blu.-gy 5 green	1 purple 2 " 1 lav.-gy	1 blu.-gy 2 " 3 "	1 yel.-gy 2 " 3 "	1 gray 2 " 3 "	1 lt. gy 2 " 3 "
A	1 gray 2 greenish 3 gy-gre	1 red-gy 2 reddish 3 red-gy	1 bluish 2 blu.-gy —	1 yellow 2 yel.-gy 3 yellow	1 dk. gy 2 " 3 "	1 lt. gy 2 " 3 "

(2) In this part of the experiment in connection with reports on contrast-effects we secured some data on color-matching. On 6 paper discs (blue, red, yellow, purple, orange, green) were pasted rings of white paper, one-half in. in width. On these rings were pasted sectors of black paper, so that the ring and disc might be equal in brightness. *O* was given a number of small discs (yellow, orange, green, blue, purple, red, black, white). *E* first placed the green paper disc on the electric color-mixer and, having received a description of the contrast-color of the ring, illustrated to *O* how it was possible to combine some of the smaller discs so that when they were rotated on another color-mixer, placed beside the first, the resulting color should match that of the contrasting ring. Following this explanation the different colored discs were in turn put on the mixer. The instructions were: "You saw how I put some of these colors together so that, when the color-mixer was turned on, the resulting color matched the inside ring. Now I want you to do the same. I shall put different colors on the electric mixer, and I want you, by putting some of these colored discs on this mixer, to get colors which will match the inside rings. You may use as many or as few discs as you like."

Results.—With the exception of *M.* all the *Os* seemed to have had some idea of the proper manner in which to attack the problem. Although *M.* reported contrast-effects from all colors except purple, she apparently had no idea how she might match the hue and brightness of the ring by combining certain of the colored discs. *B.* and *K.* did not always recognize a contrast-color, but they always attempted to match for brightness. They were at first more perplexed by the problem than the older *Os* and were more easily discouraged when good results were not immediately obtainable. *K.* occasionally departed from the particular problem in his interest in combining various odd colors to observe results. *J.* always attempted to match for both hue and brightness. She was very persistent in her efforts to secure satisfactory results. *I.*, like *B.* and *K.*, attacked the problem blindly at first. She always attempted to match for brightness, but she failed to recognize any contrast-color from the purple. *F. B.* and *A.*, after a careful analysis of contrast-hue and brightness, always attempted to match for both.

The most interesting feature of this experiment was the care and patience shown by the *Os* in matching the contrast-color. Some of the *Os* changed their combinations from 14 to 23 times before they were satisfied with the matches. This result shows that young *Os* can be depended upon for long and care-requiring pieces of work, provided they understand clearly the problem to be solved.

GENERAL CONCLUSIONS

The experimental work that we have done with children has shown that they can be used as observers in psychological experiments; that they can give accurate and reliable descriptions of their experiences. Training in laboratory procedure is essential, but this is also the case with adult observers. Short observation-periods to avoid fatigue and monotony are desirable, and they should be made as frequent as possible.

The chief difficulties, and these are not unsurmountable, are (1) the use of language that children can understand, (2) the absolute necessity of framing instructions so as to avoid suggestion.

The conditions of this experimental work have been somewhat crude, but they show that with training more elaborately planned experimental work can be carried out. There is no evidence from our work that the children were "unnatural" in the laboratory. Quite to the contrary, once a child had been in the laboratory, its surroundings were taken for granted, and the reports showed no traces of artificiality. Indeed, the observation periods seemed to be enjoyed.

When we compare the children with the two college girls who observed in the experiments, we find that the children show more variability in their attitude and in their reports. This lack of stability decreased with training, but in our work it always had to be dealt with. There was considerable variation from week to week, so that at times it seemed as if the previous week's training had been of no value. There is no doubt, however, but that the interval between observation-periods was too long, and that more frequent observation-periods would favor stability of attitude. On the other hand, the reports of the children were quite as good in most instances as those of the two older *O*s, if we take into consideration the difference in ability to use language. As we have pointed out, the two older *O*s used more exact color names and more carefully chosen words in describing their experiences.

The children, on their side, were more spontaneous in their reports. There seemed always to be more effort on the part of the older *O*s to give what the experimenter "wanted" than on the part of the children, who burst forth into naïve descriptions of what they "saw" without any thought of its being "right" or "wrong." They tended, too, much less toward interpretations of their reports.

As we have said at the beginning of this paper, our purpose was not to make any contributions to the child-psychology of visual sensation. What we have shown, however, is that a psychology of childhood can be built up experimentally. It will take time and patience and some ingenuity, but the results will be worth the effort.